

## Marine Blue-Green Algae from Palawan in the Philippines

## 1. Chroococcales and Oscillatoriales

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The present paper deals with the marine blue-green algae belonging to the orders of Chroococcales and Oscillatoriales from Palawan and from small collections in Mindanao and Mactan, the Philippines. The Chroococcales includes five families, 13 genera and 14 species. Of which three are new to the Philippine marine flora. Chroococcaceae: *Microcrocis sabulicola*, *Dalmatella buaensis* and *Hormathonema paulocellula*. *Hyella palawaniae* sp. nov. in the Hydrococcaceae is described. The Oscillatoriales comprises four families, 14 genera and 43 species. *Schizothrix creswellii* in the Schizotrichaceae, *Sirocoleum kurzii* in the Phormidiaceae and *Hormoscilla xishaensis* in the Oscillatoriaceae are new to the Philippine marine flora. *Phormidium calciphilum* sp. nov. and *P. endospongelliae* sp. nov. are described in the Phormidiaceae. *Blennothrix confluens* (Setch. et Gardn.) comb. nov. (= *Microcoleus confluens* Setch. et Gardn. in Gardn. 1918) is given in the Oscillatoriaceae.

In the Philippines, studies on the blue-green algae were few, because of the interruption of the World War II until 1947 (Velasquez and Soriano 1957). According to them 127 species and 2 forms of blue-green algae belonging to 34 genera in 9 families were reported up to 1957. Velasquez (1962) further examined all the blue-green algal specimens from the Philippines and enumerated 162 species and 3 forms, including marine species. Martines (1984) published a checklist of blue-green algae of the Philippines and listed 361 species including 130 marine species. According to Martinez (1984), most of the reported marine blue-green algae were collected from Pangasinan, Luzon (Saraya and Trono 1979), Batangas, Luzon (Cornejo and Velasquez 1970), Manila Bay, Luzon (Vannajan and Trono 1977), Cebu (Almase 1970), Aklan, Panay (Cordero 1978,

1981), Dumaguete City and Siquijor Province, Negros (Reyes 1970, 1976), and Mindanao (Fortes and Trono 1979). Umezaki and Modelo (1987), who were members in the first scientific expedition under the title "Scientific survey of marine algae and their resources in the Philippines" with the grant from the Ministry of Education, Science and Culture of Japan from November 16, 1985 to December 14, 1985, studied the marine blue-green algae in the Visayas (Panay, Cebu, Bohol and Leyte islands) and found 51 species belonging to 26 genera in 7 families and 2 orders.

Palawan is an island facing the Sulu Sea on the east coast and the South China Sea on the west side and is the fifth largest island of the country, 11,785 km<sup>2</sup>. It is ca. 440 km long and 4.5–42 km wide, lying approximately between 12° and 8° North latitude (Fig. 1).

Velasquez (1955) recorded 30 species of blue-

green algae from Palawan, of which three, *Oscillatoria chalybea*, *Lyngbya majuscula* and *Hormothamnion solutum* were from marine habitats. Trono (1982) collected *Lyngbya majuscula* from Bugsuk island, Palawan. However, marine blue-green algal flora has

not extensively been studied yet.

I had a chance to collect marine blue-green algae in Palawan, during the second scientific expedition under the same title above mentioned from October 8, 1987 to November 14, 1987.

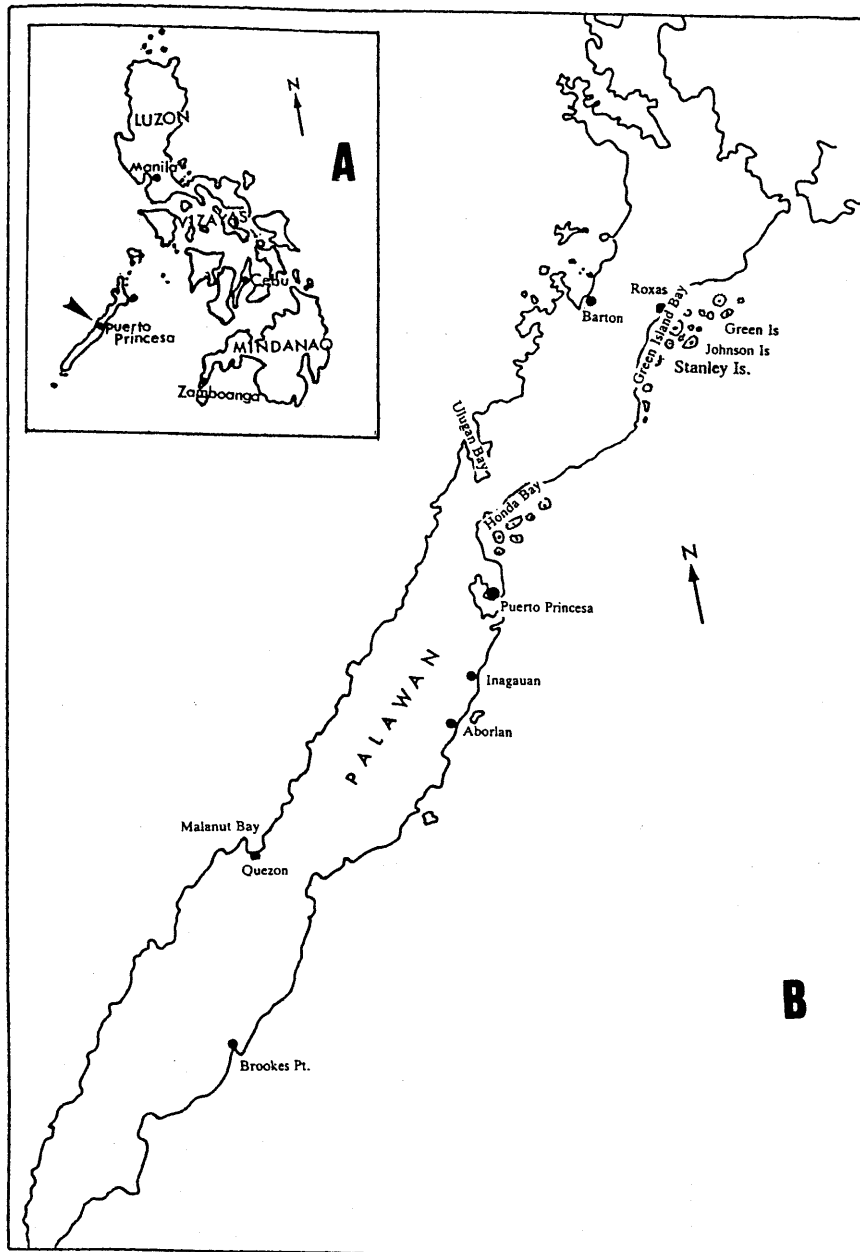


Fig. 1. A. Map showing the Philippine Islands. B. Map showing locations of collection in Palawan.

The samples were collected from rocks and coral reefs in the intertidal zone and from the basal trunks and creeping roots of mangrove and its aerial roots in the intertidal zone or a little above the high tide level. Particular attention was focused on the collection of coral fragments and/or alive and mostly dead mollusk shells coloured deep blue-green in which endolithic or lime perforating species were commonly found growing.

Specimens examined are deposited in the Herbarium, Division of Tropical Agriculture, Faculty of Agriculture, Kyoto University, Kyoto, Japan and their duplicates are deposited in the Philippine National Museum, Manila, Philippines.

The arrangement of taxa in the present work (Part 1. Chroococcales and Oscillatoriales; and part 2. Nostocales and Sigonematales) is based on Komárek and Anagnostidis (1986) for the Chroococcales, Anagnostidis and Komárek (1988) for the Oscillatoriales, Komárek and Anagnostidis (1989) for the Nostocales, and Anagnostidis and Komárek (1990) for the Stigonematales.

The following is a list of localities and dates of collection in Plawan and Mindanao and Cebu where blue-green algal specimens for this study were collected.

### Palawan

#### Puerto Princesa

##### a) Puerto Princesa Bay

Barbas Is., Buguias Is., Pandan Is., Marcelo Is. (Oct. 10, 1987)

##### b) Honda Bay

Cowry Is., Bat Is. (Oct. 12, 1987)

##### c) Puerto Princesa

Barangay Liberty, Barangay Tacan, Barangay Sta. Lucia, Rohta Point, Sta. Lucas, Kamagong, Sta. Lucia (Oct. 14, 1987)  
Cana Is., Turtle Is., near mouth, Binunsalian Bay, Panagtaran Point (Oct. 17, 1987)

##### d) Barangay Ulugan

Rita Is., Oyster Inlet, Sagumay Point, Nasudan (Tapnipa Inlet) (Nov. 2, 1987)  
Marupinas, near Underground River (Nov. 3, 1987)

##### e) Barangay Inagauan

Asinan, Tagbarungis (Nov. 6, 1987)

##### f) Barangay Kamuning

Baryawan, Sabang (Nov. 7, 1987)

#### Roxas (Green Island Bay)

Green Is., Pandan Is. (Oct. 21, 1987)  
Shell Is., Johnson Is., Purao Is., Sand Formation, near Shell Is. (Oct. 22, 1987)  
Howley Is., Stanley Is., Flat Is., Small Pagbo Is. (Oct. 23, 1987)

#### San Vicente (Barangay Port Barton)

Cacnipa Is., Punta Burabob (Oct. 24, 1987)  
Boayan Is., Paradise Is., German Is. (Oct. 25, 1987)  
Double Is., Ausan Is., Quering Is., Velasco Is., Port Barton (Oct. 26, 1987)

#### Quezon

Cidanao Is., Tadtaran Is. (Jan. 15, 1987)  
Tabon Cave (Jan. 16, 1988)

#### Brookes Point

Town Proper, Barangay Uringuring (Jan. 8, 1987)  
Mid-reef (Jan. 11, 1988)

#### Aborlan

Barangay Iraan (Jan. 11, 1988)

### Mindanao

#### Zamboanga

Upper Calarian (Jan. 23 and 25, 1988)  
Santa Cruz Is. (Jan. 24, 1988)

### Cebu

#### Mactan

Near Marine Station, University of San Carlos (Jan. 29, 1988)  
*Caulerpa* farm (Jan. 30, 1988)  
Cordova (Feb. 1, 1988)

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#### **Chroococcales** Wettst.

##### **Microcystaceae** Elenk.

Aphanothecoideae Kom. et Anagn.

*Gloeotheca rupestris* var. *tepidariorum* (A. Br.) Hansg. 1891

Puerto Princesa

Barangay Ulugan: Marupinas, among the filamentous blue-green algae growing on freshwater dripping rocks one meter above the sea surface, 7656.

Merismopedioideae (Elenk.) Kom. et Anagn.

*Merismopedia glauca* (Ehrenb.) Kütz. 1845

Puerto Princesa

Barangay Liberty: Among the sand grains in intertidal rock depressions, together with *Microcrocis sabulicola*, 7216.

Turtle Bay: Among the filaments of *Lyngbya semiplena*, 7447.

*Microcrocis sabulicola* (Lagerh.) Geitl. 1942

Puerto Princesa

Barangay Liberty: Among sand grains in intertidal rocks depressions, together with *Meris-*

*mopedia glauca*, 7215.

*Microcrocis sabulicola* is new to the Philippine marine flora.

*Snowella lacustris* (Chodat) Kom. et Hind. 1988

Puerto Princesa

Honda Bay: Cowry Is., among the filaments of a diatom, *Biddulphia pulchella* epiphytic on *Sargassum* sp., 7192.

#### **Chroococcaceae** Näg.

*Chroococcus turgidus* (Kütz.) Näg. 1849

Puerto Princesa

Honda Bay: Cowry Is., among the filaments of *Cladophoropsis zollingeri* in intertidal rock depressions, 7194.

Barangay Ulugan: Oyster Inlet, among the filaments of *Bostrychia tenella*, 7617b.

Roxas (Green Island Bay)

Howley Is.: Among the filaments of *Lyngbya aestuarii*, 7399.

San Vicente (Barangay Port Barton)

Punta Burabob: Among the filaments of *Bostrychia* sp., together with *Phormidium nigroviridis*, 7763a.

Synechococcoideae Kom. et Anagn.

*Johannesbaptistia pellucida* (Dickie) W. R. Taylor et Drouet in Drouet 1938

Puerto Princesa

Honda Bay: Cowry Is., among sand grains in the intertidal zone and among the filaments of *Microcoleus chthonoplastes*, 7198.

#### **Chamaesiphonaceae** Borzi

*Chamaecalyx clavatus* (Setch. et Gardn.) Kom. et Anagn. 1986

Puerto Princesa

Barangay Ulugan: Oyster Inlet, on *Bostrychia tenella*, together with *Dermocarpella hemispaherica*, 7626a.

#### **Dermocarpellaceae** Ginsb.-Ardre ex Christ.

*Dermocarpella hemispaherica* Lemm. 1907

Puerto Princesa

Barangay Ulugan: Oyster Inlet, on *Bostrychia tenella*, together with *Chamaecalyx clavatus*, 7626b.

*Cyanocystis prasina* (Reinsch) Kom. et Anagn. 1886

Puerto Princesa

Barangay Ulugan: Oyster Inlet, on the branches of *Bostrychia tenella*, 7617a.

*Stanieria sphaerica* (Setch. et Gardn.) Anagn. et Pantaz. 1991

Puerto Princesa

Puerto Princesa Bay: Buguias Is., on the filaments of *Lyngbya majuscula*, 7149.

### **Hydrococcaceae** Kütz.

*Dalmatella buaensis* Erceg. 1929

Puerto Princesa

Honda Bay: Cowry Is., in the shells of a mollusk living on coral rocks in the intertidal zone, 7209.

*Dalmatella buaensis* Erceg. is new to the Philippine marine flora.

*Hormathonema paulocellula* Erceg. 1929

Puerto Princesa

Honda Bay: Cowry Is., in dead mollusk shells, together with *Mastigocoleus testarum*, 7210.

*Hormathonema paulocellula* is new to the Philippine marine flora.

*Hyella caespitosa* Born. et Flah. 1888

Puerto Princesa

Puerto Princesa Bay: Buguias Is., in oyster shells in the intertidal zone, 7135b, 7138, 7141, 7146c; in dead coral fragments in the intertidal zone, 7153. Pandan Is., in dead coral fragments in the intertidal zone, 7170.

Barangay Liberty: In dead mollusk shells in the intertidal zone, 7222, 7225.

Sta. Lucia: Rohta Point, in dead coral fragments in the intertidal zone, 7458, 7462a.

Cana Is.: In dead mollusks in the intertidal zone, 7485, 7492a; in dead coral fragments in the intertidal zone, 7491a.

Binunsalian Bay: In dead coral fragments in the intertidal zone, 7505a, 7508a, 7516; in dead shells of Cypraceae in the intertidal zone, 7508a.

Barangay Ulugan: Oyster Inlet, in dead coral stones washed ashore, 7631a.

Sagumay Point: In dead coral stones, 7639a.

Marupinas: Near Underground River, in dead mollusk shells, 7647a.

Roxas (Green Island Bay)

Pandan Is.: In dead mollusk shells, 7376, 7541a, 7543, 7544, 7547a.

Howley Is.: In oyster shells living on aerial roots of mangrove, 7410a, 7412.

Shell Is.: In dead mollusk shells, 7557a.

Roxas: In dead coral pieces in the intertidal zone, 7603.

San Vicente (Barangay Port Barton)

Capnipa Is.: In dead mollusks, 7747a; in dead coral stones, 7748a.

Port Barton: In dead mollusk shells, 7682, 7683, 7744.

Punta Burabob: In dead coral stones, 7760a; in dead mollusk shells, 7764a.

Boayan Is.: In dead coral stones, 7666a.

Double Is.: In dead mollusks, 7734a.

Ausan Is.: In dead coral stones, 7728.

Quering Is.: In oyster shells living on hanging branches of mangrove just above the sea surface, 7690, 7692; in dead coral stones, 7693a; in dead snail shells, 7700a.

Velasco Is.: In oyster shells living on the branches of mangrove, just above the sea surface, 7715a; in dead mollusk shells, 7734a.

Mindanao

Zamboanga: Santa Cruz Is., in mollusk shells in the intertidal zone, 7789a.

*Hyella caespitosa* is commonly distributed in Palawan, always in association with *Mastigocoleus testarum*, *Leptolyngbya terebrans* (= *Plectonema terebrans*), or *Gomontia*-like algae in dead mollusk

shells or dead coral fragments in the intertidal zone, sometimes in oyster shells living on hanging branches and aerial roots of mangrove.

***Hyella palawaniae* Umezaki sp. nov.** (Figs. 2, 4A)

Roxas (Green Island Bay)

Pandan Is.: In dead mollusk shells (*Tridacna* sp.) in mangrove forest near the beach, 7546a (Holotype), deposited in the Herbarium, Division of Tropical Agriculture, Faculty of Agriculture, Kyoto University; in dead coral fragments in the intertidal zone, 7548, 7549, 7550.

Thallus endolithicus, in substrata carbonatica marina penetrans; pseudofilamentis ad 200(–260)  $\mu\text{m}$  longis, 4–10-celeullis compositis, uniseriatis, lateraliter ramosis; cellula terminali cylindricis, 45–62(–75)  $\mu\text{m}$  longis; pseudovaginis hyalinis, firmissimis, crassioribus, 1.5–2.5(–5–8)  $\mu\text{m}$  crassis; sporangiis singulis vel 2–3 junctis, 20–25  $\times$  60–110  $\mu\text{m}$  crassis; baeocystis 2–3.5  $\mu\text{m}$  crassis.

Filaments perforating in mollusk shells or dead coral fragments; pseudofilaments up to 200(–260)  $\mu\text{m}$  long, composed of up to 10-cells, simple or once

or twice branched; the basal cells larger than the other cells, later changing into sporangia, yellowish brown, 17–20  $\times$  25–30  $\mu\text{m}$  in size; the terminal cells longer than other cells, 45–62(–75)  $\mu\text{m}$  long; pseudosheaths hyaline, distinct, not lamellated, 1.5–2.5(–5–8)  $\mu\text{m}$  thick; sporangia single or 2–3-celled, 20–25  $\times$  60–110  $\mu\text{m}$  in size, endospores 2–3.5  $\mu\text{m}$  in diam.

*Hyella palawaniae* differs from *H. caespitosa* Born. et Flah. (1888) by the following characters: The pseudofilaments are shorter and composed of fewer cells; and the pseudosheaths are distinct and thicker. The pseudofilaments of *H. caespitosa*, however, are composed of ten cells or more and often several times branched and their pseudosheaths are thin and often hydrolized. The new species is also different from *H. littorinae* Setch. et Gardn. in Gardn. (1918) by these characters: The pseudofilaments are longer; their terminal cells are longer; and their basal cells from which several filaments are produced together are longer. In *H. littorinae* the pseudofilaments are 75–85  $\mu\text{m}$  long and their terminal cells are 20–30  $\mu\text{m}$  long. *H. palawaniae* is distinct from *H. caerulea* L. Hoffmann (1989), which was found in dead coral fragments by its non-lamellated sheath.

**Oscillatoriales** Elenk.

**Pseudanabaenaceae** Anagn. et Kom.

*Leibleinia epiphytica* (Hieron. ex Kirchn.) Compère 1985

Puerto Princesa

Puerto Princesa Bay: Buguias Is., on the filaments of *Lyngbya majuscula*, 7148, 7166.

Honda Bay: Cowry Is., on the filaments of *Lyngbya majuscula*, 7182.

Roxas (Green Island Bay)

Pandan Is.: On the filaments of *Blennothrix cantharidosma*, 7360b.

Green Is.: On the filaments of *Leibleinia polychroa*, 7392b.

Johnson Is.: On the filaments of *Blennothrix cantharidosma*, 7567b.

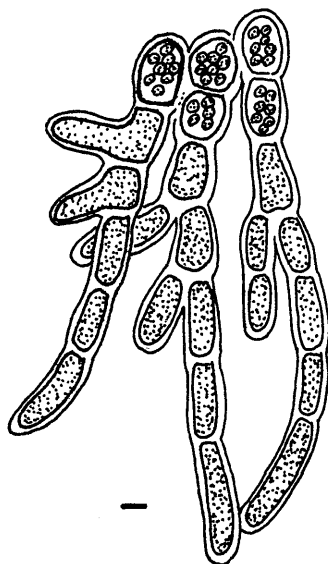


Fig. 2. *Hyella palawaniae* Umezaki. Three filaments having sporangia. Scale bar: 10  $\mu\text{m}$ .

- San Vicente (Barangay Port Barton)  
 Punta Burabob: On the filaments of *Lyngbya majuscula*, 7767.  
 Ausan Is.: On the filaments of *Lyngbya confervoides*, 7708b.
- Leibleinia gracilis* Menegh. 1844
- San Vicente (Barangay Port Barton)  
 Punta Burabob: On *Sphacelaria* sp. growing on *Sargassum* sp., 7756a.
- Leibleinia nordgaardii* (Wille) Anagn. et Kom. 1988
- San Vicente (Barangay Port Barton)  
 Punta Burabob: On *Sphacelaria* sp. growing on *Sargassum* sp., together with *Leibleinia gracilis*, 7756b.
- Leibleinia pellucida* (Umez.) Umez. et Watan. 1944
- Puerto Princesa  
 Paragtaran Point: On the sheaths of *Blennothrix cantharidosma*, 7525.
- Leibleinia polychroa* Menegh. 1844; Umez. and Watan. 1944
- Puerto Princesa  
 Honda Bay: Cowry Is., on *Cladohoropsis zollingeri*, 7204.  
 Barangay Tacan: On *Corallina* sp. in the intertidal zone, 7444; on *Gelidiella acerosa*, 7450.  
 Rohta Point: Sta. Lucas, on *Corallina* sp. in the intertidal zone, 7452, 7453.  
 Binunsalian Bay: On rocks in the intertidal zone, 7501.
- Roxas (Green Island Bay)  
 Green Island: On *Sargassum* sp., 7382, 7392a.  
 Pandan Is.: On rocks and on small marine algae in the intertidal zone, 7345, 7446a.  
 Howley Is.: On *Cymodocea* sp., 7407.  
 Stanley Is.: On *Hypnea* sp. in the intertidal zone, 7417a.  
 Flat Is.: On the aerial roots of mangrove, 7420.  
 Shell Is.: Among the branches of *Dichothrix penicillata*, 7552c; on coral reef rocks in the intertidal zone, 7554.
- San Vicente (Barangay Port Barton)  
 Cactnipa Is.: Floating on sea surface, 7677; on coral rocks along high tide level, 7679.  
 Paradise Is.: Floating on sea surface, 7749.
- Brookes Point  
 Barangay Uringuring: On *Galaxaura* sp. and other algae in the intertidal zone, 7780.
- Leptolyngbya crosbyana* (Tilden) Anagn. et Kom. 1988
- Puerto Princesa  
 Honda Bay: Cowry Is., on coral reef in the intertidal zone, 7177, 7183, 7208.  
 Binunsalian Bay: On rocks in the intertidal zone, 7495.
- Roxas (Green Island Bay)  
 Stanley Is.: On coral rocks in the intertidal zone, 7416.
- Cebu  
 Mactan Is.: Cordova, on rocks in the intertidal zone, 7791.
- Leptolyngbya fragilis* (Menegh. ex Gom.) Anagn. et Kom. 1988
- Puerto Princesa  
 Panagtaran Point: On coral rocks in the intertidal zone, 7523.
- Leptolyngbya rivulariarum* (Gom.) Anagn. et Kom. 1988
- Puerto Princesa  
 Barangay St. Lucia: Kamagong, in the fronds of *Rivularia polyotis*, 7466.  
 Turtle Bay: On the sheaths of *Blennothrix cantharidosma* and *B. lyngbyacea*, 7503a.  
 Barangay Inagauan: Asinan, in the fronds of *Rivularia polyotis*, 7426b, 7443.
- San Vicente (Barangay Port Barton)  
 Quering Is.: Among the filaments of *Rivularia polyotis*, 7696b, 7698b.
- Leptolyngbya terebrans* (Born. et Flah. ex Gom.) Anagn. et Kom. 1988
- Puerto Princesa

Puerto Princesa Bay: Buguias Is., in the shells of oyster living on the aerial roots of mangrove, together with *Mastigocoleus testarum* and *Hyella caespitosa*, 7146b; in coral fragments in the intertidal zone, 7171.

Barangay Liberty: In dead mollusk shells, together with *Mastigocoleus testarum*, 7230.

Barangay Ulugan: Marupinas, near Underground River, in mollusk shells living on lime rocks one meter above the high tide level, 7655.

#### San Vicente (Barangay Port Barton)

Punta Burabob: In dead coral fragments in the intertidal zone, 7760c.

Quering Is.: In the shells of oyster living on the aerial roots of mangrove just above the high tide level, 7690b.

Velasco Is.: In the shells of oyster living on the aerial roots of mangrove just above the high tide level, 7715.

#### Mindanao

Zamboanga: Santa Cruz Is., in mollusk shells in the intertidal zone, 7789b.

### Schizotrichaceae Elenk.

*Schizothrix creswellii* Harv. ex Gom. 1892

#### Roxas (Green Island Bay)

Green Is.: On *Dictyosphaeria cavernosa*, together with *Calothrix crustacea*, 7385b.

*Schizothrix creswellii* Harv. ex Gom. is new to the Philippine marine flora.

*Schizothrix lacustris* A. Braun ex Gom. 1892

#### Puerto Princesa

Honda Bay: Cowry Is., among filamentous blue-green algae growing on mollusk shells in the intertidal zone, 7174.

#### San Vicente (Barangay Port Barton)

Double Is.: On coral rocks in the intertidal zone, together with *Blennothrix cantharidosma*, *Lyngbya semiplena* and others, 7702.

### Phormidiaceae Anagn. et Kom.

*Phormidium calciphilum* Umezaki sp. nov. (Figs.

3A, 4B)

#### San Vicente (Barangay Port Barton)

Velasco Is.: Perforating in the surface layer of dead coral fragments in the intertidal zone, 7740 (Holotype), deposited in the Herbarium, Division of Tropical Agriculture, Kyoto University.

Filamentis endolithicis, in sub superficie crescentibus, 5–7  $\mu\text{m}$  crassis; vaginis hyalinis, irregulariter crassioribus; trichomatibus 3.5–5  $\mu\text{m}$  crassis, apice non attenuatis, ad genicula non constrictis; cellulis 1–2-plo longioribus; cellula apicalis rotundata, calyptra nulla.

Filaments endolithic, gregarious, perforating into the surface layer of dead coral fragments, 5–7  $\mu\text{m}$  in diam.; sheaths hyaline, thickened irregularly; trichomes 3.5–5  $\mu\text{m}$  diam., their apices not attenuated, not constricted at cross walls; cells 1–2 times as long as the diameter; apical cells rounded, without calyptra.

*Phormidium calciphilum* differs from *P. endolithicum* Erceg. (1932, p. 161), which was found perforating in lime rocks on Sv. Arandul and Ciove islands, Yugoslavia by the characteristics: The trichomes are not attenuated at the apices and the sheaths are irregularly thickened at the surface.

*Phormidium submembranaceum* (Ardisson et Straff.) Gom. 1892

#### Puerto Princesa

Barangay Inagauan: Asinan, on rocks in the intertidal zone, 7438.

Binunsalian Bay: On coral reef or on the stratum of *Laurencia* sp. in the intertidal zone, 7517.

*Phormidium corallinae* (Kütz. ex Gom.) Anagn. et Kom. 1988

#### Puerto Princesa

Barangay Liberty: Among the filaments of *Blennothrix lyngbyacea*, 7218.

Marupinas Point: Near Underground River, in



muddy mats in the intertidal zone, 7653c.

**Phormidium endospongeliae** Umezaki sp. nov. (Figs. 3B, 4C)

Roxas (Green Island Bay)

Green Is.: In sponges living on coral reef in the intertidal zone, 7373 (Holotype), deposited in the Herbarium, Division of Tropical Agriculture, Faculty of Agriculture, Kyoto University.

Filamentibus inter spongiis sparsis, leviter curvatis, interdum abrupte curvatis, 120–180  $\mu\text{m}$  longis, 3.5–5  $\mu\text{m}$  crassis, ad genicula non vel leviter constrictis; cellulis 5–10  $\mu\text{m}$  longis, diametro paulo longioribus vel ad 2-plo longioribus; contentu homogeneo palum caeruleo-viridis; cellula apicalis capitata vel rotundata, calyptra nulla; propagatio hormogoniis.

Filaments growing solitarily in a sponge, slightly curved, sometimes abruptly bended, 120–180  $\mu\text{m}$  long, 3.5–5  $\mu\text{m}$  in diam., not or slightly constricted at cross walls; cells 5–10  $\mu\text{m}$  long, a little longer than the diameter; cell contents homogenous, pale blue-green; terminal cells capitated or rounded, without calyptra;

reproduction by hormogonia.

*Phormidium endospongeliae* differs from *P. spongeliae* (Schulze) Gom. 1892, which was found growing in a sponge (*Spongelia pallescens*), a species found in the Adriatic Sea by the characteristics that the trichomes are a little slender and that the cells are longer than the diameter. In *P. spongeliae* the trichomes are 7.5–8.5(–12)  $\mu\text{m}$  in diam. and their cells are 2.7–7.3  $\mu\text{m}$  long.

*P. molle* (Kütz) Gom. 1892

Puerto Princesa

Honda Bay: Cowry Is., on coral reef in the intertidal zone, 7180, 7189, 7201, 7206.

*Phormidium nigro-viridis* (Thw.) Anagn. et Kom. 1988

Puerto Princesa

Binunsalian Bay: On the stratum of *Leibleinia polychroa*, 7504.

Panagtaran Point: On coral reef rocks in the intertidal zone, 7527, 7532a.

Roxas (Green Island Bay)

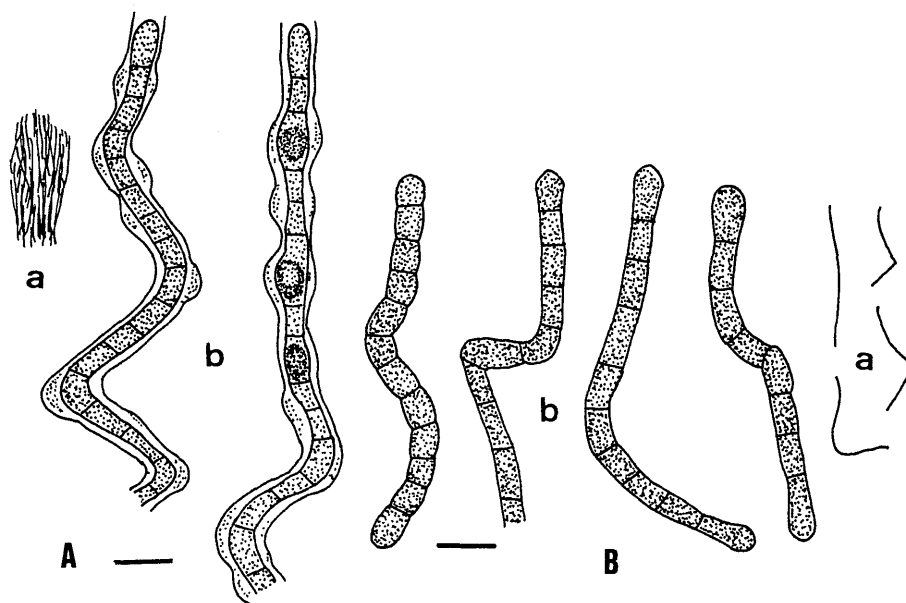


Fig. 3. A. *Phormidium calciphilum* Umezaki. a. Habit of thallus. b. Two filaments. B. *Phormidium endospongeliae* Umezaki. a. Habit of filaments. b. Four filaments. Scale bars: 10  $\mu\text{m}$ .

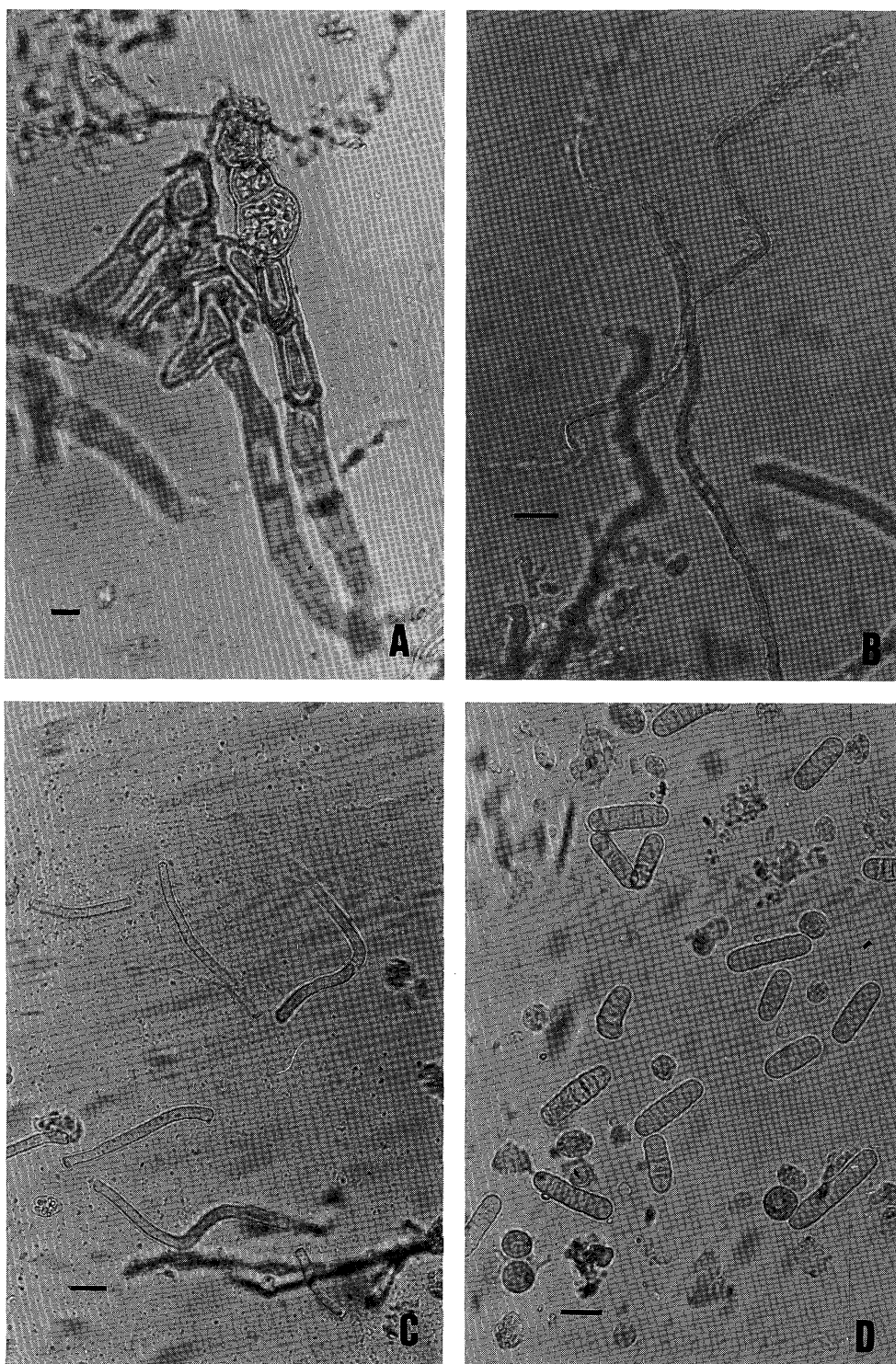


Fig. 4. A. *Hyella palawaniae* Umezaki. B. *Phormidium calciphilum* Umezaki. C. *Phormidium endospongelliae* Umezaki. D. *Hormoscilla xishaensis* (H. Hua) Anagn. et Kom. Scale bars: 10  $\mu$ m.

Green Is.: On coral reef rocks in the intertidal zone, 7354b.

Howley Is.: On the aerial roots of mangrove, 7401b, 7403.

Shell Is.: In rock depressions on the coral reef in the intertidal zone, 7553.

San Vicente (Barangay Port Barton)

Double Is.: Among the filaments of *Scytonematopsis pilosa*, 7705b.

Barton: On the aerial roots of mangrove in the intertidal zone, 7722; among the branches of *Bostrychia* sp. growing on rocks along high tide level, 7752.

Punta Burabob: Among the branches of *Bostrychia* sp. growing on rocks along high tide level, 7763b.

*Phormidium penicillatum* Gom. 1893

Synonym: *Lyngbya penicillata* (Gom.) L. Hoffm. 1989

Roxas (Green Island Bay)

Johnson Is.: On the leaves of seagrass, 7569.

Purao Is.: On coral reef rocks in the intertidal zone, 7581.

Cebu

Mactan Is.: Cordova, on rocks in the intertidal zone, 7782, 7792.

*Porphyrosiphon lutea* (Ag. ex Gom.) Anagn. et Kom. 1988

Puerto Princesa

Pandan Is.: On the shells of sea mussel, 7176.

Barangay Inagauan: Asian, on the basal trunk of mangrove, 7428.

Cana Is.: On rocks in the intertidal zone, together with *Scytonematopsis pilosa*, 7490.

San Vicente (Barangay Port Barton)

Ausan Is.: On rocks in the intertidal zone, 7711.

*Porphyrosiphon martensiana* (Menegh. ex Gom.) Anagn. et Kom. 1988

San Vicente (Barangay Port Barton)

Barton: On or among the branches of *Gelidium*

sp. in the intertidal zone, 7712.

*Symploca hydroides* Kütz. ex Gom. 1892

Puerto Princesa

Buguias Is.: On coral reef rocks in the intertidal zone, 7157, 7161.

Barangay Inagauan: Asinan, among the plants of *Bostrychia* sp. growing on the basal trunk of mangrove, together with *Lyngbya majuscula*, 7427b.

Binunsalian Bay: On rocks in the intertidal zone, 7500.

Panagtaran Point: On the stratum of *Laurencia* sp. in the intertidal zone, 7518.

Barangay Inagauan: Oyster Inlet, on the aerial roots of mangrove, 7625.

Roxas (Green Island Bay)

Pandan Is.: On coral reef rocks in the intertidal zone, 7372, 7374, 7380, 7381.

Howley Is.: On the aerial roots of mangrove, 7397, 7400.

Johnson Is.: On coral reef rocks in the intertidal zone, 7582, 7589, 7590.

Roxas: On coral reef rocks in the intertidal zone, 7604.

San Vicente (Barangay Port Barton)

Paradise Is.: On rocks in the intertidal zone, 7604.

Velasco Is.: On rocks and dead coral fragments in the intertidal zone, 7738.

Punta Burabob: Among the plants of *Bostrychia* sp. growing on rocks a little above the high tide level, 7771.

*Trichodesmium contortum* Wille 1903

Puerto Princesa

Puerto Princesa: Planktonic in the sea, 7776c.

Quezon: Planktonic in the sea, 7778a.

*Trichodesmium hildebrandtii* Gom. 1892

Puerto Princesa: Planktonic in the sea, 7776d.

*Trichodesmium thiebautii* Gom. 1892

Quezon:

Cidano Is.: Planktonic in the sea, 7777, 7778b.

Subfam. Microcoleoideae Hansg.

*Hydrocoleum glutinosum* Ag. ex Gom. 1892

Puerto Princesa

Buguias Is.: On rocks in the intertidal zone, 7151, 7158; on the leaves of *Halodule pinifolia*, 7160

Pandan Is.: On the plant masses of *Amphiroa* sp. and *Hypnea* sp., 7164

Barangay Liberty: On coral reef rocks in the intertidal zone, 7220, 7224.

Barangay Sta. Lucia: Rohta Point, on coral reef rocks in the intertidal zone, 7454.

*Microcoleus chthonoplastes* Thur. ex Gom. 1892

Puerto Princesa

Turtle Bay: Among the filaments of *Scytonematopsis pilosa* and *Bostrychia* sp. in the intertidal zone, 7131.

Honda Bay: Cowry Is., on coral reef rocks in the intertidal zone, 7190.

Barangay Inaguan: Asinan, on the aerial roots of mangrove, together with *Scytonema polycystum*, 7429b.

Barangay Sta. Lucia: Rohta Point, on mollusk shells in the intertidal zone, 7456.

Cana Is.: On rocks in the intertidal zone, together with *Blennothrix lyngbyacea* and *Lyngbya aestuarii*, 7486b.

Barangay Ulugan: Marupinas, near Underground River, on rocks in the intertidal zone, 7651c. Oyster Inlet, on rocks in the intertidal zone, 7627. Rita Is., on pebbles along high tide level, 7632.

San Vicente (Barangay Port Barton)

Ausan Is.: On rocks in the intertidal zone, 7712a.

Barton: On mud covered rocks in the intertidal zone, under mangrove trees, 7723.

Punta Burabob: Among the branches of *Bostrychia* sp. growing on rocks along high

tide level, 7753; among the filaments of *Scytonematopsis pilosa*, 7758.

Boayan Is.: On rocks in the intertidal zone, together with *Microcoleus tenerrimus* and *Lyngbya aestuarii*, 7763b.

Velasco Is.: On dead coral fragments in the intertidal zone, 7687a.

Quering Is.: Among the branches of *Bostrychia* sp. growing on rocks a little above the high tide level, 7697a.

Roxas (Green Island Bay)

Pandan Is.: Among the filaments of *Leibleinia polychroa*, 7346c.

*Microcoleus tenerrimus* Gom. 1892

Puerto Princesa

Buguias Is.: Among the filaments of *Sphacelaria* sp. growing on floating log, 7134.

Turtle Bay: On dead coral fragments washed ashore on beach, 7126.

Honda Bay: Cowry Is., on mud covered rocks in the intertidal zone, together with *Sirocoleum kurzii*, 7186.

Cana Is.: Oyster Inlet, on rocks in the intertidal zone, 7611a, 7619c.

Roxas (Green Island Bay)

Johnson Is.: On dead coral fragments in the intertidal zone, 7592b.

San Vicente (Barangay Port Barton)

Boayan Is.: On rocks in the intertidal zone, together with *Microcoleus chthonoplastes* and *Lyngbya aestuarii*, 7663a, 7669b.

Barton: On dead coral fragments in the intertidal zone, 7742.

*Sirocoleum kurzii* (Zeller) Gom. 1892

Puerto Princesa

Honda Bay: Cowry Is., on mud covered coral rocks in the intertidal zone, 7185

*Sirocoleum kurzii* is new to the Philippine marine flora.

Subfam. Spirulinoideae Forti

*Spirulina major* Kütz. ex Gom. 1892.

Puerto Princesa

Honda Bay: Cowry Is., among the branches of *Cladophoropsis zollingeri*, 7195.

*S. princeps* W. et G.S. West 1902

Puerto Princesa

Puerto Princesa Bay: Planktonic in the sea, 7776a.

*Spirulina subsalsa* Oerst. ex Gom. 1892

Roxas (Green Island Bay)

Stanley Is.: Among the filaments of *Leibleinia polychroa*, 7417b.

Shell Is.: Among the filaments of *Dichothrix penicillata*, 7552d.

*Spirulina subtilissima* Kütz. ex Gom. 1892

Synonym: *Spirulina labyrinthiformis* (Gmel.)

Gom. 1892; Umezaki and Modelo 1987

Puerto Princesa

Panagtaran Point: On coral reef rocks in the intertidal zone, 7536.

Barangay Ulugan: Marupinas, near Underground River, on the sheaths of *Blennothrix lyngbyacea*, 7648b.

Roxas (Green Island Bay)

Pandan Is.: On the sheaths of *Blennothrix cantharidosma*, 7360c.

*Spirulina tenerrima* Kütz. ex Gom. 1892

Puerto Princesa

Binunsalian Bay: On the sheaths of *Blennothrix cantharidosma* and *B. lyngbyacea*, together with *Leptolyngbya rivulariarum*, 7503b.

**Oscillatoriaceae** (S.F. Gray) Harv. ex Kirchn.

**Hormosilloideae** Anagn. et Kom.

*Hormoscilla xishaensis* (H. Hua) Anagn. et Kom. 1988 (Fig. 4D)

Puerto Princesa

Barangay Tacan: On coral reef rocks in the intertidal zone, 7446b.

The filaments collected at Barangay Tacan, Puerto Princesa are 20–60  $\mu\text{m}$  long, 7.5–12.5  $\mu\text{m}$  in diam.,

composed of 4–15 cells. The trichome cells are 2–3  $\mu\text{m}$  long. *Hormoscilla xishaensis* is new to the Philippine marine algal flora.

**Oscillarioideae** Gom.

*Blennothrix cantharidosma* (Mont.) Anagn. et Kom. 1988

Synonyms: *Hydrocoleum majus* Holden, 1899;

*Hydrocoleum holdenii* Tilden ex Tilden 1910;

*Blennothrix majus* (Hold.) Anagn. et Kom. 1988

Puerto Princesa

Buguas Is.: On the leaves of *Halodule pinifolia*, 7159; on coral reef rocks in the intertidal zone, 7162.

Barangay Liberty: On coral reef rocks in the intertidal zone, 7162.

Binunsalian Bay: On rocks in the intertidal zone, 7496, 7497, 7502.

Turtle Bay: On sponge mats in the intertidal zone, 7469; on *Gracilaria* sp., 7373.

Panagtaran Point: On coral reef rocks in the intertidal zone, 7524.

Roxas (Green Island Bay)

Pandan Is.: On rocks in the intertidal zone, together with *Leibleinia polychroa*, 7346b, 7349, 7351, 7360a.

Johnson Is.: On *Padina* sp. in the intertidal zone, together with *Dichothrix penicillata*, 7565; on seagrasses, 7567a, 7586a.

Purao Is.: Among the branches of *Jania* sp. and *Cladophoropsis* sp. in the intertidal zone, 7572, 7574, 7576, 7577.

San Vicente (Barangay Port Barton)

Cacnipa Is.: On the leaves of *Sargassum* sp., together with *Blennothrix lyngbyacea*, 7750a.

German Is.: On dead coral fragments in the intertidal zone, 7687a.

Velasco Is.: On dead coral fragments in the intertidal zone, 7687a.

Quezon

Tavon Cave: On rocks in the intertidal zone,

7781.

## Cebu

Mactan Is.: Cordova, on rocks in the intertidal zone, 7790.

## Mindanao

Santa Cruz Is.: On rocks in the intertidal zone, 7788.

The trichomes from Mindanao (7788) are (25–) 30–37.7  $\mu\text{m}$  in diam. whose diameter agrees well with that of *Hydrocoleum majus* Holden (1899), however, other characteristics agree well with those of *Blennothrix cantharidosma* (Mont.) Anagn. et Kom. 1988.

*Blennothrix confluens* (Setch. et Gardn.) comb. nov.

Basionym: *Microcoleus confluens* Setch. et Gardn. in Gardn., Univ. Calif. Publ. Bot. 6: 471, 1918.

Synonym: *Hydrocoleum confluens* (Setch. et Gardn.) Drouet, Field Mus. Nat. Hist. Bot. Ser. 20: 134, 1942.

## Roxas (Green Islands Bay)

Green Is.: Among the utricles of *Codium* sp., 7387.

The characteristics of *Microcoleus confluens* Setch. et Gardn. in Gardn. (1918) agree well with the diagnosis of *Blennothrix* Kütz. ex Anagnostidis and Komárek (1988).

*Blennothrix lyngbyacea* (Kütz. ex Gom.) Anagn. et Kom. 1988

## Puerto Princesa

Puerto Princesa Bay: Pandan Is., on the leaves of *Cymodocea* sp., 7486a.

Barangay Liberty: In rock depressions on the coral reef in the intertidal zone, 7217, 7223.

Barangay Sta. Lucia: Kamagong, on coral reef rocks in the intertidal zone, 7467.

Honda Bay: Cowry Is., on coral reef rocks in the intertidal zone, 7179.

Barangay Ulugan: Marupinas Point, on muddy mats in the intertidal zone, together with *Lyngbya semiplena*, 7648a, 7653b; Oyster In-

let, on aerial roots of mangrove, 7616c.

## Roxas (Green Island Bay)

Green Is.: On oil balls floating on the sea surface, 7379.

Pandan Is.: On coral reef rocks in the intertidal zone, 7356.

Purao Is.: Among the branches of *Jania* sp. and *Cladophoropsis* sp. in the intertidal zone, 7573.

Howley Is.: On the aerial roots of mangrove, 7408.

Roxas: On coral reef rocks in the intertidal zone, 7597a, 7599, 7601.

## San Vicente (Barangay Port Barton)

Cacnipa Is.: On the leaves of *Sargassum* sp. in the intertidal zone, together with *Blennothrix cantharidosma*, 7750b.

Punta Burabob: On rocks in the intertidal zone, 7765; among the filaments of *Lyngbya confervoides*, 7773.

Quering Is.: On rocks along high tide level, 7699b.

Velasco Is.: On dead coral stones in the intertidal zone, 7686a, 7687b.

*Oscillatoria bonnemaisonii* Crouan ex Gom. 1892

## Puerto Princesa

Panagtaran Point: On the fronds of *Symploca hydroides*, together with *Oscillatoria margaritifera*, 7519a.

## Roxas (Green Island Bay)

Green Is.: Among the filaments of other blue-green algae and red algae in intertidal rock depressions, 7386.

Shell Is.: In coral rock depressions along high tide level, 7562.

*Oscillatoria margaritifera* (Kütz.) Gom. 1892

## Puerto Princesa

Panagtaran Point: Among the filaments of *Oscillatoria bonnemaisonii*, 7519b; on the stromatolite of *Hypnea* sp., together with *Phormidium nigro-viridis*, 7532b; on coral reef rocks in the

intertidal zone, 7533.

Puerto Princesa Bay: Planktonic in the sea, 7776b.

Puerto Princesa: Among the filaments of *Pseudodichotomosiphon constricta*, 7779.

#### Roxas (Green Island Bay)

Green Is.: Among the filaments of *Cladophoropsis* sp., 7375; among the filaments of *Lyngbya majuscula*, 7389b.

Shell Is.: Among the filaments of *Dichothrix penicillata*, 7552b.

Purao Is.: In rock depressions along high tide level, 7578; on *Halimeda* sp. in the intertidal zone, 7580.

Howley Is.: Among the filaments of *Lyngbya majuscula*, 7406b.

#### San Vicente (Barangay Port Barton)

Barton: Among the sand grains in the intertidal zone, 7717.

#### *Lyngbya aestuarii* (Mert.) Lyngb. ex Gom. 1892

##### Puerto Princesa

Honda Bay: Cowry Is., on coral reef rocks in the intertidal zone, 7187, 7188.

Barangay Tacan: On coral reef rocks in the intertidal zone, 7445, 7446a; on *Halimeda* sp., 7449.

Cana Is.: On rocks in the intertidal zone, 7486c.

Turtle Bay: On stones in the intertidal zone, 7132.

Binunsalian Bay: On rocks in the intertidal zone, 7498.

Panagtaran Point: On the stratum of *Gracilaria* sp. in the intertidal zone, 7520; on coral reef rocks in the intertidal zone, 7526.

Barangay Inagauan: Asinan, on the aerial roots of mangrove, 7430.

#### Roxas (Green Island Bay)

Pandan Is.: On the leaves of seagrass, together with *Dichothrix penicillata*, 7347a.

Green Is.: On coral reef rocks in the intertidal

zone, 7354a; on the aerial roots of mangrove, 7394.

Roxas: On sandy beach in the intertidal zone, 7606.

#### San Vicente (Barangay Port Barton)

Boayan Is.: On rocks in the intertidal zone, together with *Microcoleus chthonoplastes* and *M. tenerrimus*, 7663c, 7669a.

#### *Lyngbya confervoides* C. Ag. ex Gom. 1892

##### Puerto Princesa

Puerto Princesa Bay: Buguias Is., on the leaves of seagrass, 7268.

Honda Bay: Cowry Is., on the leaves of seagrass, 7200, 7202, 7207.

Barangay Ulugan: Marupinas, near Underground River, on rocks in the intertidal zone, 7649.

#### Roxas (Green Island Bay)

Johnson Is.: On coral reef rocks in the intertidal zone, 7585, 7588a, 7591.

#### San Vicente (Barangay Port Barton)

Punta Burabob: On rocks along high tide level, 7755, 7766, 7769, 7772.

Boayan Is.: On rocks in the intertidal zone, 7661.

Paradise Is.: On rocks in the intertidal zone, 7674.

Ausan Is.: On rocks in the intertidal zone, 7708a.

#### *Lyngbya majuscula* (Dillw.) Harv. ex Gom. 1892

##### Puerto Princesa

Puerto Princesa Bay: Barbas Is., floating as a mass of filaments, 7133. Buguias Is., on coral reef rocks in the intertidal zone, 7147, 7163.

Honda Bay: Cowry Is., on coral reef rocks in the intertidal zone, 7181, 7199.

Barangay Inagauan: Asinan, among the branches of *Bostrychia* sp. growing on the basal trunk of mangrove, 7427a.

#### Roxas (Green Island Bay)

Green Is.: On *Sargassum* sp., 7383, 7388, 7389a.

Shell Is.: On *Gelidiella acerosa* in the intertidal zone, 7560, 7561.

Small Pagbo Is.: On *Sargassum* sp., 7421, 7422.

Roxas: On coral reef rocks in the intertidal zone, 7596, 7605.

*Lyngbya semiplena* (C. Ag.) J. Ag. ex Gom. 1892

#### Puerto Princessa

Barangay Liberty: In intertidal rock depressions, together with *Hydrocoleum glutinosum*, 7221.

Barangay Tacan: On *Carpopeltis* sp. and *Corallina* sp. in the intertidal zone, 7448.

Turtle Bay: On rocks in the intertidal zone, 7471, 7478c, 7480.

Panagtaran Point: On coral reef rocks in the intertidal zone, 7529, 7531, 7534.

Barangay Ulugan: Marupinas, near Underground River, on muddy mats in the intertidal zone, 7653a. Oyster Inlet, on rocks and among the filaments of *Scytonema ocellatum* in the intertidal zone, 7611c, 7613a.

#### Roxas (Green Island Bay)

Green Is.: On the leaves of seagrass, 7355.

Pandan Is.: On coral reef rocks in the intertidal zone, 7359, 7363, 7364a.

Shell Is.: On the aerial roots of mangrove, 7551b, 7555.

Johnson Is.: On coral reef rocks in the intertidal zone, 7588b, 7593.

Howley Is.: On the leaves of *Cymodocea* sp., 7406a.

Flat Is.: On the aerial roots of mangrove, 7418b.

#### San Vicente (Barangay Port Barton)

Boayan Is.: On rocks in the intertidal zone, together with *Scytonematopsis pilosa*, 7662b, 7664, 7665a.

Paradise Is.: On rocks in the intertidal zone, together with *Scytonema polycystum*, 7675b,

7678.

Double Is.: On coral reef rocks in the intertidal zone, 7703.

Velasco Is.: Among the filaments of *Scytonematopsis pilosa*, 7713b.

Barton: On rocks along high tide level, 7716a.

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梅崎 勇：フィリピン、パラワン島の海産藍藻類

# 1. クロオコックス目及びユレモ目

クロオコックス目には5科13属14種が記録された。新種 *Hyella palawaniae* が記載された。*Microcrocis sabulicola*, *Dalmatella buaensis* 及び *Hormathonema paulocellula* はフィリピン新産種であった。ユレモ目には4科14属43種が記録された。2新種 *Phormidium calciphilum* と *P. endos-*

*pongelliae* が記載され、新組合せ *Blennothrix confluens* (Setch. et Gardn.) comb. nov. が提唱され、*Schizothrix creswellii*, *Sirocoleum Kurzii* 及び *Hormoscilla xishaensis* はフィリピン新産種であった。